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Viscous and acoustic properties of AlCu melts

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Abstract

© 2016, Pleiades Publishing, Inc.The atomic dynamics of the binary Al100–xCux system is simulated at a temperature T = 973 K, a pressure p = 1.0 bar, and various copper concentrations x. These conditions (temperature, pressure) make it possible to cover the equilibrium liquid Al100–xCux phase at copper concentrations 0 ≤ x ≤ 40% and the supercooled melt in the concentration range 40% ≤ x ≤ 100%. The calculated spectral densities of the time correlation functions of the longitudinal (Formula Presented) (k, ω) and transverse (Formula Presented) (k, ω) currents in the Al100–xCux melt at a temperature T = 973 K reveal propagating collective excitations of longitudinal and transverse polarizations in a wide wavenumber range. It is shown that the maximum sound velocity in the νL(x) concentration dependence takes place for the equilibrium melt at an atomic copper concentration x = 10 ± 5%, whereas the supercooled Al100–xCux melt saturated with copper atoms (x ≥ 40%) is characterized by the minimum sound velocity. In the case of the supercooled melt, the concentration dependence of the kinematic viscosity ν(x) is found to be interpolated by a linear dependence, and a deviation from the linear dependence is observed in the case of equilibrium melt at x < 40%. An insignificant shoulder in the ν(x) dependence is observed at low copper concentrations (x < 20%), and it is supported by the experimental data. This shoulder is caused by the specific features in the concentration dependence of the density ρ(x).

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